Spacial Occurrence of 91 Intertidal Animal Species on Hatakejima Island, 1983

AUTHOR(S):

Ohgaki, Shun-ichi; Abe, Naoya; Takegami, Toshiya; Wada, Keiji

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On 13th May and 23rd August in 1983, members of the Seto Marine Biological Laboratory carried out the investigation on the distribution of 91 species of intertidal animals on Hatakejima Island (the Experimental Field of the Seto Marine Biological Laboratory; 33°42′N, 135°22′E) in order to monitor the recent biotic state of its coastline.

The 91 species were selected because of the easiness in search and identification in the field by their large sizes. The intertidal area of Hatakejima Island was divided into four "Areas" which correspond to the west, north, east and south shores of the island (Fig. 1). Areas I and II faced the innermost part of Tanabe Bay and were

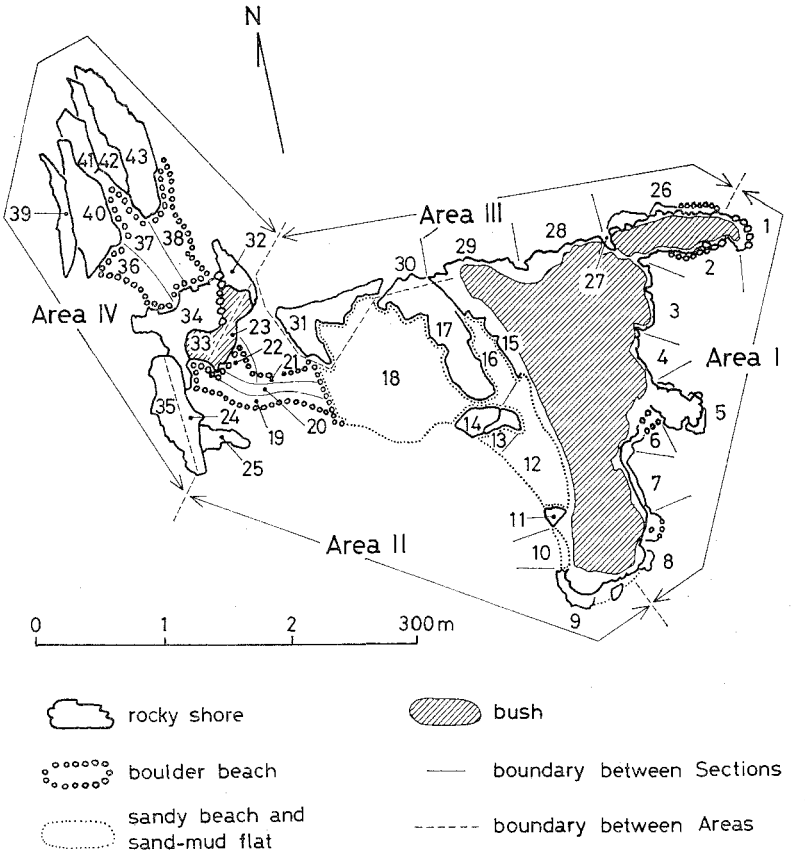

Fig. 1. Map of Hatakejima Island showing Areas and Sections. Arabian numerals indicate Section numbers.

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less exposed than Areas III and IV which faced the bay mouth (for the general feature of the island, see Tokioka, 1969, Publ. Seto Mar. Biol. Lab., 17: 1–6). Each of the Areas was subdivided into "Sections" and the number of the Sections was 43 in all. Relative abundance of 57 species on rocky shore and 51 species on boulder beach, sand beach and sand-mud flat were evaluated and classified into four ranks: abundant, common, rare and not found. It took 20 to 30 min. for 5 to 8 persons to complete the survey in one Section. The results are shown in Tables 1 and 2.

Rocky shore (Table 1)

On rocky shore, the following 13 species were searched besides the species listed in Table 1, but were not found in any Sections: *Diloma suavis, Nerita albicilla, Heminerita japonica, Planaxis surcatus, Clypeomorus humilis, Siphonaria sirius, Modiolus auriculatus, Hormomya mutabilis, Asterina pectinifera, Holothuria pardalis, Pseudocentrotus depressus, Echinometra mathaei* and *Tripneustes gratilla.* For each of the following 6 species, only one individual was encountered: *Serpulorbis imbricatus, Japeuthria ferrea, Diadema setosum, Mespilia globulus, Holothuria leucospilota* and *Afrocucumis africana.* For the 25 species commonly found on rocky Sections, three patterns of relative abundance among the four Areas were recognized (Table 3). Among the 25 species, 5 were most abundant in the sheltered Area I, 10 were most abundant in the exposed Area IV and the other 10 were equally abundant in all the Areas.

Boulder Beach, Sand Beach and Sand-mud Flat (Table 2)

On boulder beach, sand beach and sand-mud flat, the following 4 species were searched besides the species listed in Table 2, but were not found in any Sections: *Siphonaria sirius, Mespilia globulus, Pseudocentrotus depressus* and *Tripneustes gratilla.* On Hatakejima Island, boulder beaches of considerable expansion are located in Sections 2 and 6 (Area I), Sections 19 to 22 (Area II) and Sections 36 to 38 (Area IV). For the 24 species commonly found in the boulder Sections, three patterns of occurrence among the above three Areas were recognized (Table 4). Among the 24 species, 12 were widely recorded from Areas I, II and IV, 9 were from Areas II and IV, and the other 3 were exclusively from Area IV. Therefore, if the estimation is confined to the above 24 species, more species tend to be found in more exposed beaches.

Comparison with the Previous Data

In 1970 and 1971, distributions of two mussels, *Hormomya mutabilis* and *Modiolus agripetus* (=*M. auriculatus*) were investigated in the intertidal area of Hatakejima Island (Senawong, 1972, Publ. Seto Mar. Biol. Lab., 19: 269–291). At that time *H. mutabilis* was found on the whole coast and *M. auriculatus* mainly in the western half of the island. Their carpet-like colonies were observed in many places on the rocky shore. In 1983, however, none of the two mussels were found in the whole intertidal area of the island.

Distribution of sea urchins around Hatakejima Island was investigated in 1975 (Takahata et al., 1984, Nanki-seibutu, 26: 25–29). At that time, *Anthocidalis*

crassispina, Echinostrephus aciculatus, Echinometra mathaei and *Mespilia globulus* were distributed in all the Areas (I to IV). *Pseudocentrotus depressus* was found in Areas I and IV, and *Hemicentrotus pulcherrimus* in Areas III and IV. However, in 1983, the ranges of *A. crassispina* and *E. aciculatus* were limited to Areas III and IV, that of *M. globulus* and *H. pulcherrimus* were limited to Area IV, and *E. mathaei* and *P. depressus* were not found on the whole coast. Thus, sea urchins in general were distributed widely around the island in 1975 but were restricted to the exposed shores in 1983.

Participants: N. Abe, Y. Fukui, H.K. Nakamura, S. Ohgaki, S. Ohtsuka, H. Tanase, T. Takegami, K. Takenouchi, K. Wada, K. Yoshimura.

Shun-ichi Ohgaki
Naoya Abe
Toshiya Takegami
Keiji Wada

Seto Marine Biological Laboratory
Kyoto University
Shirahama, 649-22, Japan

Table 1. Relative abundance of 43 species on rocky shore of Hatakejima Island.

cc: abundant, c: common, r: rare, blank: not found.

Species	Area	I								II								III						IV									
	Section	1	2	3	4	5	6	7	8	9	11	14	15	17	23	24	25	26	27	28	29	30	31	32	33	34	35	39	40	41	42	43
Cnidaria																																
Anthopleura japonica Verrill		c	cc	cc	c	c	c	cc	c	cc	cc	cc	c	cc	r	c	c	c	r	c	c	c	cc	c	r	c	c	c	c	r	r	c
Tentaculata																																
Zoobotryon pellucidum Ehrenberg		c	cc	cc	cc	cc	r	c	cc						r		r	r		r	r		r	c								
Dakaria subovoidea (d'Orbigny)		c	c	c	c	r	r	c	c			r	r	r	c	cc	cc	cc	c	c	r	r	r	cc		c	cc	c	c	c	c	c
Annelida																																
Pomatoleios kraussi (Baird)		c	c	c	c	cc	r	cc	c	c	cc	c	c	c	c	cc	cc	c	c	c	c	cc	c	c	r	cc	cc	c	c	c	c	c
Arthropoda																																
Pollicipes mitella (Linné)		c	r	r	r					c		c	r		c	r		c	r	r	r		c	c	r	c		c	cc	cc	cc	cc
Chthamalus challengeri Hoek		cc	cc	cc	cc	c	cc	c	cc	cc	cc	cc	c	cc	cc	cc	c	cc	c	cc	cc	cc	cc	cc	c	cc	cc	cc	cc	cc	cc	cc	cc
Balanus albicostatus albicostatus Pilsbry			r	r	r	r	r	r	r		r	r	r	r		r	r				r	r	r		r		r						
B. amphitrite amphitrite Darwin		r	c	cc	cc	cc	cc	cc	cc	cc	c	cc	c	c	r	r	c	r	r	c	c	c	c	r	r	r	c		r				r
B. tintinnabulum volcano Pilsbry		c		c		r							r			c		c		c	c	c	r	r		c		c	c	c	cc	r
Tetraclita squamosa japonica Pilsbry		r				r						r	cc	r	r	r	r	cc	r	cc	cc	cc	cc		r	cc		cc	cc	cc	cc	cc
Clibanarius virescens (Krauss)		c		c	c	c		c	r		c			c		c		c					cc	r			c	c	r	c	c	r
Pagurus geminus McLaughlin			r			r	c	c			c	c	r	c				c	r						r	r			r			r
Hemigrapsus sanguineus (De Hann)						r		r																	r							
Gaetice depressus (De Hann)			r					r						r																		
Mollusca																																
Liolophura japonica (Lischke)		r	r							r	r	c		c	r	r		cc	r	c	c		c	c	r	cc	c	cc	c	cc	cc	cc
Cellana toreuma (Reeve)											r				r			r	c	c				r		r	r	c	c	c	c		
C. grata (Gould)		r																	r	r						r		r			c		
C. nigrolineata (Reeve)		c										c		r	c			r	c					r		c		c	c	c	c	c
Collisella heroldi (Dunker)		c	c					c	c	c	c	c		c	c	c		c	c	cc	c		c	c	c	c	c	c	c	c	cc	c	
Patelloida saccharina (Linné)		c	c			c	c	r	c	cc	c	c	r	cc	c	c	r	c	r	cc	c		cc	cc	c	c	cc	cc	cc	cc	cc	cc	cc

Monodonta labio (Linné)												r		c			r	c					c	c	c							
Lunella coronata (Gmellin)																							r									
Littorina brevicula (Philippi)	c	c	r	c	c	c	c	c	c	c	c	c	r	r	c		c	c	c	c		c		r		c	r	r	r			
Nodilittorina exigua (Dunker)	c	r	c	c	c	r		c	c	c	c	r					c		cc	cc			r	c	c	c		c		c	r	c
N. pyramidalis (Quoy et Gaimard)											c																					
Serpulorbis imbricatus (Dunker)																										r						
Batillaria cumingii (Crosse)												c																				
Thais clavigera (Küster)		r							r														r				r	r				c
Japeuthria ferrea (Reeve)														r																		
Siphonaria japonica (Donovan)	c	c	c		c		c	c	c	c	c		r	c	c	r			cc	cc		c	c	r	c	c				c	c
S. acmaeoides Pilsbry													r						r	r		r						r		c		
Adula atrata (Lischke)	r	c	c	r	c	c		r	r	r	r	r	c	r	r				c	c		r	r		r	r						r
Septifer virgatus (Wiegman)	r		r							r	r				r	r	r		c	c		r	r		r		c	c	c	c	c
Mytilus edulis Linné	r	r	r	c	r	c	c	c	r	r		r		r	cc	cc	c		cc	cc	cc	cc	r		c		cc	c	c	cc	c
Echinodermata																																
Asterina coronata japonica Hayashi																												r				r
Diadema setosum (Leske)																						r										
Mespilia globulus (Linné)																												r				
Hemicentrotus pulcherrimus (A. Agassiz)																											r		r			
Echinostrephus aciculatus A. Agassiz																			r	r	c	c			r	cc	cc	cc	cc	cc	c	
Anthocidaris crassispina (A. Agassiz)																	r	r	c	c	c	c	c		c	cc	cc	cc	cc	cc	cc	
Holothuria leucospilota (Brandt)																																r
Afrocucumis africana (Semper)																							r									
Protochordata																																
Styela plicata (Lesueur)		c		cc	cc	cc	r	c	cc											r			r								

Table 2. Relative abundance of 43 species on boulder beach, sand beach and sand-mud flat of Hatakejima Island.
cc: abundant, c: common, r: rare, blank: not found.

Species	Section	Boulder beach									Sand beach		Sand-mud flat		
		2	6	19	20	21	22	36	37	38	10	12	13	16	18
Cnidaria															
Actinia equina (Linné)							c								
Anthopleura japonica Verrill		c	c	r	r		r	c		r					
Haliplanella luciae (Verrill)		c	c	c	c	r	c	c	c						
Tentaculata															
Dakaria subovoidea (d'Orbigny)		c						r							
Annelida															
Eunice aphroditois (Pallas)										c					
Pomatoleios kraussi (Baird)		c		c	r	c	c	c	c	c					
Arthropoda															
Chthamalus challengeri Hoek		cc		r	c		cc	c	cc	c					
Balanus albicostatus albicostatus Pilsbry				r	r										
B. amphitrite amphitrite Darwin		r	c	c	c	c	c	r	r	r					
Tetraclita squamosa japonica Pilsbry					r										
Clibanarius virescens (Kruass)		cc		cc		cc	cc	cc	r	cc					
Pagurus geminus McLaughlin			r	cc	c	c	cc	c	r	c			cc	c	
P. dubius (Ortmann)													cc		
Petrolisthes japonicus (De Haan)		cc		cc	c	cc	cc	cc	cc	cc					
Leptodius exaratus (H. Milne Edwards)		c	c	c	r	c	c	c		c					
Etisus laevimanus Randall		r				c									
Pilodius nigrocrinitus Stimpson		c						c		c					
Pilumnus vespertilio (Fabricius)		c					r			r					
Hemigrapsus sanguineus (De Haan)		c	r	c	c	c	cc	c	c	c					
H. penicillatus (De Haan)														c	
Gaetice depressus (De Haan)		r	cc	c	cc	c	cc	cc	cc	c			c	c	

Nanosesarma gordoni (Shen)	c		c	r	c	cc	c	c	c					
Ocypode stimpsoni Ortmann										c	c			
Mollusca														
Liolophura japonica (Lischke)			c		c	cc	c	cc						
Acanthochitona defilippii (Tapparone Canefri)			c	c										
Cellana toreuma (Reeve)			r			r	cc	c	c					
C. nigrolineata (Reeve)								cc	r					
Patelloida saccharina (Linné)			c		c	cc	c	cc	c					
Monodonta labio (Linné)			cc	cc	c	cc	c	cc					r	
Lunella coronata (Gmelin)					r	c	r						r	
Littorina brevicula (Philippi)		c		c										
Batillaria cumingii (Crosse)													cc	
Thais clavigera (Küster)						r	r							
Japeuthria ferrea (Reeve)							r	c						
Echinodermata														
Asterina batheri Goto						r								
A. coronata japonica Hayashi							c		r					
Hemicentrotus pulcherrimus (A. Agassiz)							c							
Anthocidaris crassispina (A. Agassiz)						r	r		r					
Holothuria moebi (Lüdwig)					r	r	c		c					
H. paldalis Selenka						r	c		c					
Afrocucumis africana (Semper)						r	c		c					
Polycheira rufescens (Brandt)			c	r	r	c	cc	c	r					
Hemicordata														
Balanoglossus carnosus (Willey)														cc

Table 3. Patterns of relatvie abundance of common rocky shore animals in the four Areas.

Pattern of abundance	Species
I>II, III, IV	*Zoobotryon pellucidum, Balanus amphitrite amphitrite, Littorina brevicula, Adula astrata, Styela plicata*
IV>I, II, III	*Pollicipes mitella, Balanus tintinnabulum volcano, Tetraclita squamosa japonica, Liolophura japonica, Cellana grata, C. nigrolineata, Patelloida saccharina, Septifer virgatus, Echinostrephus aciculatus, Anthocidaris crassispina*
Equally abundant in the four Areas	*Anthopleura japonica, Dakaria subovoidea, Pomatoleios kraussi, Chthamalus challengeri, Clibanarius virescens, Pagurus geminus, Collisella heroldi, Nodilittorina exigua, Siphonaria japonica, Mytilus edulis*

Table 4. Patterns of occurrence of common boulder shore animals. Boulder shores in Hatakejima Island are located in Areas I, II and IV.

Pattern of occurrence	Species
IV	*Cellana nigrolineata, Japeuthria ferrea, Asterina coronata japonica*
II & IV	*Liolophura japonica, Cellana toreuma, Pattelloida saccharina, Monodonta labio, Holothuria moebii, Polycheira rufescens, Anthocidaris crassispina, Holothuria pardalis, Afrocucumis africana*
I, II & IV	*Anthopleura japonica, Haliplanella luciae, Pomatoleios kraussi, Chthamalus challengeri, Balanus amphitrite amphitrite, Clibanarius virescens, Pagurus geminus, Petrolisthes japonicus, Leptodius exaratus, Hemigrapsus sanguineus, Gaetice depressus, Nanosesarma gordoni*